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IS 11494 (1986, Reaffirmed 2009): Code for Construction and Maintenance of Surface Farm Drainage Systems. UDC 631.62.004.5



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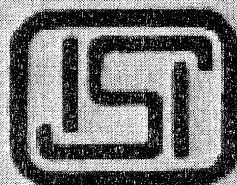
**IS : 11494 - 1986**

(Reaffirmed 2000)

*Indian Standard*

**CODE FOR  
CONSTRUCTION AND MAINTENANCE OF  
SURFACE FARM DRAINAGE SYSTEMS**

UDC 631.62.004.5



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**INDIAN STANDARDS INSTITUTION**

MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG

NEW DELHI 110002

# *Indian Standard*

## CODE FOR CONSTRUCTION AND MAINTENANCE OF SURFACE FARM DRAINAGE SYSTEMS

Farm Drainage Sectional Committee, AFDC 47

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*Indian Standard*  
**CODE FOR  
CONSTRUCTION AND MAINTENANCE OF  
SURFACE FARM DRAINAGE SYSTEMS**

**0. FOREWORD**

**0.1** This Indian Standard was adopted by the Indian Standards Institution on 31 January 1986, after the draft finalized by the Farm Drainage Sectional Committee had been approved by the Agricultural and Food Products Division Council.

**0.2** Surface drainage is normally required for efficient crop production on slowly permeable soils with restricted topography. It is not required when excess water is removed naturally. The objectives of surface drainage are:

- a) To prevent water from ponding on land surface or in surface drains that are crossed by farm equipment,
- b) To remove excess water in time to prevent damage to crops, and
- c) To accomplish the above without excess erosion.

**0.3** Complete drainage systems shall be planned and designed after considering all aspects. The collection system consisting of the land surface and shallow drains removes excess surface water from individual areas within fields. The disposal system consisting of some what larger ditches receives drainage water from the collection system and removes it from the farm. Transitions, including structures, that permit drains to discharge into larger or deeper drains must provide for adequate erosion control without holding water on field surfaces for excessive periods of time. The system shall be designed as an integrated component of the land and water management activity on the farm.

**0.4** This standard is intended to serve as a guide for proper construction and maintenance of surface drainage systems in the farms.

**0.5** In preparation of this standard, assistance has been derived from ASAE EP 302 : 2-1973 'Design and construction of surface drainage systems on farms in humid areas', published by the American Society of Agricultural Engineers, USA.

**0.6** For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960\*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

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## **1. SCOPE**

**1.1** This standard covers the recommended practice for construction and maintenance of surface farm drainage systems.

## **2. TERMINOLOGY**

**2.1** For the purpose of this standard definitions given in IS : 11495-1986 † shall apply.

## **3. DESIGN**

**3.1** Design of the surface drainage system shall be done in accordance with IS : 11495-1986†.

## **4. CONSTRUCTION**

**4.1** Good quality construction is essential for adequate drainage. Qualified engineers should be responsible for surveys, designs, layouts and checking to guarantee that construction meets specifications. Land owners and contractors shall be provided with complete information necessary for construction.

**4.1.1** Land smoothing will provide adequate drainage only if depressions are eliminated by smoothing the land surface. Row drains, field drains, and/or laterals shall be installed in the remaining low areas.

**4.1.2** Land grading is hampered by trash and vegetation which shall be destroyed or removed prior to construction and kept under control while the work is being done. Ploughing trash under the land surface is not recommended.

**4.1.2.1** Fields shall be scarified prior to construction if there are hard pans. The field surface shall be firm when surveyed so that staff readings taken at stakes will reflect the true elevations. Fields shall not be graded when wet, because this impairs the physical condition of the soil.

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\*Rules for rounding off numerical values ( *revised* ).

†Code for design of surface drainage system.

**4.1.2.2** Grading shall be checked prior to and following the finishing operations. A tolerance of 30 mm may be allowed in checking, provided there are no reverse grades in row direction.

**4.1.2.3** Land smoothers shall be passed over the field surface at least three times as a finishing operation. The first two passes shall be on opposite diagonals to the stake lines, and the last pass shall be in the row direction.

**4.1.2.4** Fields shall be scarified either before or after the final land smoothing operations to loosen the cut surfaces and to blend the fill material with the underlying soil.

**4.1.3** The slope in the direction of drainage shall usually be 0.2 to 0.4 percent.

**4.1.4** Field drains shall be constructed to facilitate quick disposal of runoff water from the cultivated areas. These may be shallow and crossable by farm equipment.

**4.1.5** Field drains shall be located along the lowest edge of the field. If the fields are long in the direction of drainage, there may be more than one field drain.

**4.1.6** Collector drains shall be constructed as per the hydraulic design and with variation in cross section if required. Such variation may be made at the point of road crossing where a permanent structure exists.

**4.1.6.1** Runoff water from the field may be allowed to fall in the collector if it is not feasible to have field drains. However, such entry points shall be planted and buried pipe outlets shall be provided from the field into the collector.

**4.1.6.2** In the event of constructing culverts at road and collector junctions, the culvert capacity should be more than the maximum designed discharge. This will ensure that the culvert will not act as a bottleneck at any time during the drainage.

**4.1.6.3** The productive soil dug out during the construction of collector drain shall be uniformly spread over the cultivated areas if possible. Otherwise, all the soil material dug out shall be used to construct farm road after the drain and to make a protective levee along the edge of the field adjacent to the drain. The loose soil shall be put at least 50 cm away from the edge of the drain to avoid falling back of the soil into the drain during monsoon.

## **5. CONSTRUCTION EQUIPMENT**

**5.1** Proper construction equipment and skilled operators are required for good quality work.

**5.1.1** Tractor and scraper combinations are used for excavating for hauling excavated material to fill areas, and for spreading excavated material. Tractors and scrapers are used for land grading, and to construct and maintain field drains and diversions. Under favourable conditions, they are used to construct and maintain field laterals with flat side slopes. Wheel type tractors have been used with scrapers for levelling when lead length is over 50 m. Self-loading (carry all) scrapers operated by tractors are used for short lead length when earth movement is heavy. Animal drawn scrapers are suitable for levelling small holding.

**5.1.2** Land smoothers, commonly known as land levellers or land planes operated by tractors are used for land smoothening or to finish land grading. They will automatically fill small low areas and remove small high areas when traversing a field. They cannot accomplish the major grading operations done by tractors and scrapers. Land smoothers are used periodically to maintain the surface of land that has previously been graded or smoothened. Animal drawn wooden flat are suitable for land smoothening in small scale operations.

**5.1.3** Motor graders and animal and tractor drawn 'V' ditchers are used to excavate relatively small channels, such as field drains or field laterals, where the excavated material can be spread or shaped along one or both sides of the channels.

**5.1.4** Draglines and beekhoes are used to construct and maintain large size drainage channels.

## **6. EROSION CONTROL**

**6.1** Erosion of deep productive soils in fields that require surface drainage may be of little direct economic importance. On shallow soils, erosion may over a period of time result in irreparable losses in productivity. Sedimentation that results from erosion obstructs nearby channels. The justifiable intensity of erosion control measures on field surfaces is, therefore, dependent on the depths of productive soils and the relative costs of preventing erosion and maintaining channels.

**6.1.1** Erosion control on land surfaces is normally required only where land grades exceed 1.0 percent or where there are reverse row grades. By concentrating water and causing it to overflow row beds, reverse row grades are a major contributing cause of erosion across rows. Graded rows, precisely constructed so that there are no reverse row grades and that each row carries its own water, are an effective erosion control practice.

**6.1.2** Field drain side slopes and the row middles immediately above the field drains are subject to rill erosion with resultant sedimentation in

the field drains. To control this erosion, portions of field drains that are 0.15 m below field level or below row middles shall be vegetated except vegetation is not necessary for field drains re-established yearly.

**6.1.3** Field drains with grades of about 0.3 percent and steeper shall be vegetated to prevent channel erosion. The initial erosive grades vary somewhat with soils.

**6.1.4** Field laterals are subject to serious erosion in some areas where they are located on erodible soils and steeper grades. These laterals should be vegetated. Where there is a doubt, the maximum permissible grade for unvegetated channels should be checked. Permissible grades are dependent on the scour conditions which are likely to occur in the channels.

**6.1.5** Sedimentation in field laterals is usually expected. In areas where sedimentation is anticipated, field laterals should be overcut 0.1 m or more to provide for sedimentation.

**6.1.6** Inlets to field laterals for surface water shall be constructed only at planned points. Continuous low levees, spread spoil or spoil banks shall prevent entry except at planned inlets.

**6.1.7** The outlets of field drains and field laterals shall be checked for erosiveness. In some cases the depths of channels can be controlled by design to reduce or eliminate erosion. In other cases the water level in the larger channels may reduce velocities sufficiently to effectively control erosion. Where additional erosion control measures are indicated, graded channel transitions shall be considered. Such transitions may be grass waterways or non-vegetated channels, depending on the erosion potential. When graded transitions are not adequate for erosion control, pipe drops, chutes, drop structures or other suitable erosion control structures shall be used.

**6.1.8** Pipe drops are relatively inexpensive, usually have long lives, and provide crossings for field roads. Pipe drops shall have design capacities of 1.25 to 1.5 times the rate of flow indicated on the drainage curves. Small diameter pipe drops are subject to blockage by debris. Hydraulic radius of the pipe line of the range 0.25 to 0.4 percent depending upon the size and overfall at the drain junction 0.15 to 0.3 below design grades shall be provided.

**6.1.9** All uncultivated field laterals, side slopes and spoil banks shall be vegetated as soon as practical after construction. Vegetative plants shall be selected for their erosion resistance, wildlife habitat and beautification values.

## 7. MAINTENANCE

**7.1** Timely maintenance is essential for continued adequate performance of a drainage system. Maintenance operations shall be planned when the system is designed. Inspection of the entire drainage system should be made following heavy rainfall, and at least once each year. Tillage operations should retain the shape of field surfaces as initially constructed. The two-way plough is desirable for primary tillage because dead furrows and back furrows can be eliminated or located to meet the needs of the drainage system. Where the one-way plough is used, dead furrows and back furrows shall be kept to a minimum, and shall be located so they will not restrict water flow. Unless dead and back furrows are parts of the drainage systems as in bedding, their locations shall be alternated annually.

**7.1.1** Field drains may require cleaning following tillage operations. When the field drains are not cultivated, weed growth shall be kept under control by mowing, spraying, or burning.

**7.1.2** Field laterals require periodic maintenance. Suitable chemical weed and bush sprays are effective in controlling cattails, willows, and other undesirable vegetation. Mowing is effective where side slopes are not steeper than 3 : 1. Controlled grazing of livestock is a good method. Laterals require clean out where excess deposition has occurred.

**7.1.3** Land grading maintenance is critical during the first year or two after construction. Settlement of the fill areas may make several annual land smoothing operations necessary. In some cases, particularly where deep fills have been made, it may be necessary to cut and fill again with tractors and scrapers to eliminate depressions and reverse row grades. It is recommended that the land planning operation be substituted for one of the secondary tillage operations. The final land maintenance operations shall be in the direction of the crop rows.

**7.1.4** Transitions shall be checked frequently for restriction of drainage. Removal of deposition downstream from the transition may be the only maintenance required.

**7.1.5** Pipe drops shall be checked and maintained to see that the flow is not restricted, that overtopping of the fills is not causing excessive erosion and that piping is not occurring along the conduits.

# INTERNATIONAL SYSTEM OF UNITS ( SI UNITS)

## Base Units

| QUANTITY                  | UNIT     | SYMBOL |
|---------------------------|----------|--------|
| Length                    | metre    | m      |
| Mass                      | kilogram | kg     |
| Time                      | second   | s      |
| Electric current          | ampere   | A      |
| Thermodynamic temperature | kelvin   | K      |
| Luminous intensity        | candela  | cd     |
| Amount of substance       | mole     | mol    |

## Supplementary Units

| QUANTITY    | UNIT      | SYMBOL |
|-------------|-----------|--------|
| Plane angle | radian    | rad    |
| Solid angle | steradian | sr     |

## Derived Units

| QUANTITY                         | UNIT    | SYMBOL | DEFINITION                      |
|----------------------------------|---------|--------|---------------------------------|
| Force                            | newton  | N      | 1 N = 1 kg.m/s <sup>2</sup>     |
| Energy                           | joule   | J      | 1 J = 1 N.m                     |
| Power                            | watt    | W      | 1 W = 1 J/s                     |
| Flux                             | weber   | Wb     | 1 Wb = 1 V.s                    |
| Flux density                     | tesla   | T      | 1 T = 1 Wb/m <sup>2</sup>       |
| Frequency                        | hertz   | Hz     | 1 Hz = 1 c/s (s <sup>-1</sup> ) |
| Electric conductance             | siemens | S      | 1 S = 1 A/V                     |
| Electromotive force <sup>a</sup> | volt    | V      | 1 V = 1 W/A                     |
| Pressure, stress                 | pascal  | Pa     | 1 Pa = 1 N/m <sup>2</sup>       |

